CLAIMS:

1. A mechanical seal for mounting to a housing containing a rotating shaft, said mechanical seal comprising:

a gland;

at least one pair of seal members disposed at least partially within the gland, said seal members including a rotary seal ring having a rotary seal face and a stationary seal ring having a stationary seal face engaging the rotary seal face; and

a shuttle member positioned relative to one of the rotary seal ring and the stationary seal ring and axially movable between a first position and a second position in response to changing pressure conditions within the mechanical seal, wherein the shuttle member is axially spaced from a non-seal face of one of the seal rings when disposed in the first position and when subjected to a first pressure condition, and is positioned adjacent to the non-seal face of the seal ring when disposed in the second position when subjected to a second pressure condition different from said first pressure condition.

2. The mechanical seal of claim 1, wherein the shuttle member generates a biasing force when disposed in at least one of the positions in response to one of the pressure conditions.

3. The mechanical seal of claim 1, wherein the shuttle member is disposed adjacent the rotary seal ring.

4. The mechanical seal of claim 1, wherein the shuttle member is disposed adjacent the stationary seal ring.

5. The mechanical seal of claim 1, wherein the shuttle member comprises a carrier element having

a first end portion adapted to be disposed proximate to the non-seal face of one of the first and second seal rings, and

a second end portion opposite the first end portion.

6. The mechanical seal of claim 5, wherein the carrier element further comprises a groove for seating a sealing element.

7. The mechanical seal of claim 6, wherein the sealing element is an O-ring.

8. The mechanical seal of claim 1, wherein the shuttle member comprises a housing having one or more grooves formed therein for seating a sealing element.

9. The mechanical seal of claim 8, wherein the housing includes first and second grooves for mounting first and second sealing elements, respectively.

10. The mechanical seal of claim 1, further comprising a sleeve adapted to be mounted about the shaft, said sleeve including a flange portion, and wherein the shuttle member is disposed between the flange and the rotary seal ring.

11. The mechanical seal of claim 10, wherein the first pressure condition is a positive pressure condition, and wherein the shuttle member is disposed in the first position during the positive pressure condition such that a first end of the shuttle member is axially spaced from the non-seal face of the rotary seal ring.

12. The mechanical seal of claim 10, wherein the second pressure condition is a negative pressure condition, and wherein the shuttle member is disposed in the second position during the negative pressure condition such that a first end of the shuttle member contacts the non-seal face of the rotary seal ring.

13. The mechanical seal of claim 1, wherein shuttle member defines a first radially extending piston area on the rotary seal ring for biasing the rotary seal ring against the stationary seal ring under the first pressure condition and a second radially extending piston area on the rotary seal ring for biasing the rotary seal ring against the stationary seal ring under the second pressure condition.

14. The mechanical seal of claim 13, wherein the first piston area is defined by an outer edge of the radially extending seal face of one of the seal rings and an axially extending, inner surface of the shuttle member.

15 The mechanical seal of claim 13, wherein the second piston area is defined by an inner edge of the radially extending seal face of one of the seal rings and an axially extending, inner surface of the shuttle member.

16. The mechanical seal of claim 13, wherein a process fluid exerts a force on the first piston area.

17. The mechanical seal of claim 13, wherein a barrier fluid exerts a force on the second piston area.

18. The mechanical seal of claim 1, further comprising

a first piston area defined by an outer edge of the radially extending seal face of one of the seal rings and an axially extending, inner surface of the shuttle member, and

a second piston area defined by an inner edge of the radially extending seal face of one of the seal rings and an axially extending, inner surface of the shuttle member.

19. The mechanical seal of claim 18, wherein the first piston area and the second piston area are about equal in size.

20. The mechanical seal of claim 18, wherein the first piston area and the second piston area are smaller than a contact area of the rotary seal face and the stationary seal face.

21. The mechanical seal of claim 18, wherein the first piston area and the second piston area are between about 50% and about 100% of a contact area of the rotary seal face and the stationary seal face.

22. The mechanical seal of claim 18, wherein the first piston area and the second piston area are about 70% of the contact area of the rotary seal face and the stationary seal face.

23. The mechanical seal of claim 1, wherein the gland comprises means for introducing a barrier fluid to the seal.

24. The mechanical seal of claim 1, further comprising a second pair of seal members disposed axially outwardly away from the first pair of seal members, said second pair of seal members including a rotary seal ring and a stationary ring.

25. The mechanical seal of claim 1, further comprising

a sleeve adapted to be mounted about the shaft, said sleeve including a flange portion, and

a shuttle stop disposed adjacent to an outer surface of the flange portion of the sleeve,

wherein the shuttle member is disposed between the shuttle stop and the rotary seal ring.

26. The mechanical seal of claim 25, wherein the second pressure condition is a negative pressure condition, and wherein the shuttle member is disposed in the second position during the negative pressure condition such that a first end of the shuttle member contacts the non-seal face of one of the seal rings.

27. The mechanical seal of claim 26, wherein the shuttle member contacts the non-seal face of the rotary seal ring.

28. The mechanical seal of claim 25, wherein the first pressure condition is a positive pressure condition and the shuttle member has a first end disposed proximate the non-seal face of one of the seal rings and a second end opposite the first end disposed proximate the shuttle stop, and

wherein the shuttle member is disposed in the first position during the positive pressure condition such that the second end of the shuttle member contacts the shuttle stop.

29. The mechanical seal of claim 1, wherein the shuttle member abuts a shuttle stop during the first pressure condition when the pressure of a process fluid in the seal is greater than the pressure of a barrier fluid in the seal to define a first piston area on the non-seal-face of the rotary seal ring.

30. The mechanical seal of claim 1, wherein the shuttle member abuts the non-seal face of the rotary seal ring during the second pressure condition when the pressure of a barrier fluid in the seal is greater than the pressure of a process fluid in the seal to define a second piston area on the non-seal-face of the rotary seal ring.

31. The mechanical seal of claim 1, wherein the shuttle member comprises:

an axially outer portion configured to overlie and seal against a stepped portion of the rotary seal ring, the axially outer portion having an inner diameter that is slightly greater than the outer diameter of the stepped portion of the rotary seal ring;

an axially inner portion that is narrower than the axially outer portion configured to overlie and seal against the flange of the sleeve; and

a step defining a radially extending wall between the axially inner portion and the axially outer portion.

32. In a mechanical seal for mounting to a housing containing a rotating shaft, the mechanical seal including a gland; at least one pair of seal members disposed at least partially within the gland, said seal members including a rotary seal ring having a rotary seal face and a stationary seal ring having a stationary seal face engaging the rotary seal face; and a shuttle member positioned relative to one of the rotary seal ring and the stationary seal ring, a method comprising

axially moving the shuttle member between a first position and a second position in response to changing pressure conditions within the mechanical seal, wherein the shuttle member is positioned adjacent a non-seal face of one of the seal rings when disposed in the first position and when subjected to a first pressure condition, and is axially separated from the non-seal face of the seal ring when disposed in the second position when subjected to a second pressure condition different from said first pressure condition.

33. The method of claim 32, further comprising generating a biasing force with the shuttle member when disposed in at least one of the first and second positions in response to one of the first and second pressure conditions.

34. The method of claim 32, further comprising disposing the shuttle member adjacent the rotary seal ring.

35. The method of claim 32, further comprising disposing the shuttle member adjacent the stationary seal ring.

36. The method of claim 32, wherein the mechanical seal further comprises a sleeve adapted to be mounted about the shaft, said sleeve including a flange portion, and wherein the shuttle member is disposed between the flange and the rotary seal ring, comprising

disposing the shuttle member in the first position when a positive pressure condition exists in the seal, such that a first end of the shuttle member is axially spaced from the non-seal face of the rotary seal ring., and

disposing the shuttle member in the second position when a negative pressure condition exists in the seal, such that a first end of the shuttle member is disposed axially adjacent to the non-seal face of the rotary seal ring.

37. The method of claim 32, further comprising

defining a first radially extending piston area on the rotary seal ring for biasing the rotary seal ring against the stationary seal ring under the first pressure condition, and

defining a second radially extending piston area on the rotary seal ring for biasing the rotary seal ring against the stationary seal ring under the second pressure condition.

38. The method of claim 32, further comprising

defining a first piston area by an outer edge of the radially extending seal face of one of the seal rings and an axially extending, inner surface of the shuttle member, and

defining a second piston area by an inner edge of the radially extending seal face of one of the seal rings and an axially extending, inner surface of the shuttle member.

39. The method of claim 38, wherein the first piston area and the second piston area are about equal in size.

40. The method of claim 38, wherein the first piston area and the second piston area are smaller than a contact area of the rotary seal face and the stationary seal face.

41. The method of claim 38, wherein the first piston area and the second piston area are between about 50% and about 100% of a contact area of the rotary seal face and the stationary seal face.

42. The method of claim 38, wherein the first piston area and the second piston area are about 70% of the contact area of the rotary seal face and the stationary seal face.

43. The method of claim 32, wherein the seal further includes a sleeve adapted to be mounted about the shaft, said sleeve including a flange portion, and a shuttle stop disposed adjacent to an outer surface of the flange portion of the sleeve, comprising

disposing the shuttle member between the shuttle stop and the rotary seal ring.

44. The method of claim 43, wherein the first pressure condition is a positive pressure condition, comprising

disposing the shuttle member in the first position during the positive pressure condition such that one end of the shuttle member contacts the shuttle stop.

45. The method of claim 43, wherein the second pressure condition is a negative pressure condition, comprising

disposing the shuttle member in the second position during the negative pressure condition such that one end of the shuttle member contacts the non-seal face of one of the seal rings.